THE JOURNAL OF RADIOLOGY
Official Publication of
The Radiological Society of North America

Announcement

THERE is a good deal of satisfaction for the officers of The Radiological Publishing Company as well as the editors of The Journal, in the fact that The Journal has been revived and will be issued regularly from now on.

The members of The Radiological Society entrusted us with a tremendous undertaking, when, at the annual meeting last December, they suggested the formation of a publishing company as a separate entity so that The Journal might be conducted on an absolute business basis.

Any one who has ever had any experience in publication work, readily appreciates the fact that to expect Dr. Allen to carry on the enormous responsibility of a publication of this kind single handed is beyond reason.

Realizing that The Journal had become a very vital thing to the members of the Society, it was the concensus of the meeting that as many as could subscribe financially to the publishing company do so in order to provide the necessary working capital to put The Journal over the hill.

It is no small task to establish a publication of this kind on a self-supporting basis, and, while the present organization has very great advantage in the work previously done, still there is very much left to be done. Those of the members who have not yet subscribed should do so at once in order that no shortage of funds may develop later that will act as an astringent on the proper and efficient administration of The Journal.

A word as to the publishing company: The Radiological Publishing Company is a Nebraska corporation. Its stock can only be purchased by members of the Society. The funds will be under the direct supervision and control of Dr. I. S. Trostler, of Chicago, treasurer, and Dr. A. F. Tyler, of Omaha, president. A Detailed monthly statement of business will be mailed to every stockholder at the close of each calendar month.

It is the desire of the Society that this publication succeed. Indeed, it is essential to the preservation of our individual and collective self-respect, purely aside from the professsional and intellectual benefits we shall all derive from a publication devoted to the scientific exposition of the functions and principles of Radiology, to see that The Journal merits the recognition it deserves as the official publication of the Society. That means every man must get behind The Journal financially, morally, physically and mentally. He must constitute himself an active agent for subscriptions and advertising.

Watch "The Journal"—It Leads!

A proposition of this magnitude and importance cannot be shifted to one or two men, however self-sacrificing they may be. This is *your* publication. The least you can do is to get behind The Journal and push

And the business end of The Journal is not all of the story. Copy must be prepared and forwarded in sufficient time to afford the editor an opportunity to plan each issue so as to give every reader the greatest possible benefit. Rome wasn't built in a day. Neither can The Journal be slapped together at the last minute by one man who finds himself confronted with the job of filling a lot of otherwise blank pages, and have it measure up to that high standard which The Radiological Society of North America has adopted and has a right to expect in keeping with its place in the professional cycle of humanitarian service. The columns are open to you. Indeed, they are yours to fill. Your membership signifies that you understand and appreciate your individual professional obligation. It becomes, then, strictly a personal question as to whether you will function and grow, or whether you will "let George do it" and drift into obsolescence.

The Journal will be published at Omaha All communications should be addressed to The Radiological Publishing Company at 511 City National Bank Building, Omaha.

A. F. TYLER,

President, The Radiological Publishing Co.

The Absorption of X-Rays by Various Media

F. K. Richtmyer, Ph. D.

Cornell University

FROM the standpoint of a clear understanding of the various phenomena connected with the x-ray region of the spectrum it is perhaps unfortunate that the application of x-rays in medicine and the laboratory study of x-rays had proceeded so far before we had knowledge of the real nature of an x-ray beam. Long before the work of Laue and Bragg, who showed that a beam of x-rays consists of a spectrum of various wave lengths in the same way that a beam of white light consists of a series of wave lengths extending from red to violet, you of the medical profession were applying x-rays in your everyday practice, and it was perfectly natural that both in the application of x-rays and in their laboratory study there should grow up a kind of "cut-and-try" terminology involving such terms as soft tubes, hard tubes, soft rays, hard rays, penetration, etc. However, in the light of more recent knowledge a careful laboratory study of x-rays reveals that practically every -ray phenomenon has its counterpart in a corresponding phenomenon in the visual region of a spectrum with which from every day observation we are fairly familiar. It is in part the purpose of this paper to emphasize the similarity of x-ray phenomenon and the optical phenomenon of the visual spectrum and yet to point out the differences. In short, I wish to emphasize the fact that whereas the laws of ordinary optical phenomena, such as light emission in characteristic spectra and absorption are so exceedingly complex, that we have been unable to formulate any general laws, the corresponding phenomena in x-rays are exceedingly simple.

If the light from an incandescent lamp be passed through a prism in conjunction with a suitable optical system there will, as you know, be thrown upon a screen a spectrum extending, so far as the eye is concerned, from the deep red through yellow, green and blue to the extreme violet. By means of a small apparatus called a diffraction grating we are able to ascertain that the wave length of the extreme red is of the order of .00007 cm; and of the extreme violet, .00004 cm. Such a spectrum we call a continuous spectrum. Its characteristics in the main do not depend upon the nature of the body which is emitting the light. A carbon filament at a given temperature will give very nearly the same *continuous*

spectrum as a tungsten filament at the same temperature. Such spectra are in general characteristic of incandescent solids.

If, however, the light from, say, the Cooper-Hewitt mercury vapor lamp is passed through a similar optical system we shall see upon the screen not a continuous spectrum, but a line spectrum. There will be, for example, two yellow lines very close together, a very brilliant green line, a faint green line, a brilliant blue line, and two violet lines quite close together. Such a spectrum is characteristic of mercury.

An entirely different spectrum, apparently showing no relation whatever to the mercury spectrum, would be obtained if light from a cadmium arc had been dispersed into a spectrum. In fact, each element has its own characteristic line spectrum, and in general there appears to be no known relation between the line spectrum of one substance and that of another. With these phenomena you are already familiar.

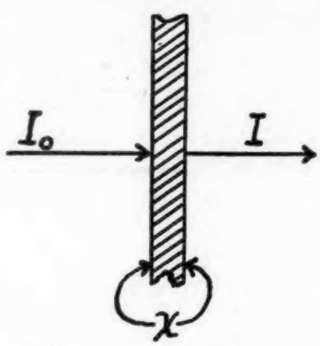
When we come to the x-ray region of the spectrum, the wave lengths of which are of the order of one ten-thousandth of the wave lengths of the visible region of the spectrum, we find these two kinds of spectrum. In short, a beam of x-ray from any target consists in general of a continuous spectrum not characteristic of the target at all, but depending only upon the voltage applied to the tube, upon which is superimposed a characteristic or line spectrum which does depend upon the nature of the target, i. e., the characteristic spectrum of a tungsten target differs from that of a molybdenum target.

But there is this difference between the x-ray characteristic spectrum and the characteristic spectrum of the elements in the visual region; whereas in the visual region there is perfect chaos when one considers the relation of the spectrum of one element to that of another there is perfect law and order in the x-ray region The characteristic x-ray spectra of the elements appear to differ from each other only as regards wave lengths. We recognize in the x-ray spectra of practically all the elements at least two series of lines known as the K series, which consists of four lines, and the L series, which consists of three groups of several lines each. The spectra of all elements appear to have the same number of lines. The only difference from one element to another being that the higher the atomic number of the element the shorter the wave length of its characteristic lines. So much for the similarities and yet the differences in the emission of x-rays and of ordinary light. When we come to consider the absorption of x-rays and of light we find a curiously similar parallelism.

In order to discuss intelligently this matter of absorption, either of x-rays or of light, it will be

necessary to define the terms "absorption coefficient" and "mass absorption coefficient." Imagine a beam of light or of x-rays falling upon a layer of absorbing material the thickness of which is X.

FIG. 1.



Let Io represent the intensity of the incident energy and I the intensity of the emergent beam. (In the optical region of the spectrum we would measure these intensities by means of a photometer; in the x-ray region of the spectrum these intensities are correspondingly measured by what is known as an ionization chamber.) The coefficient of absorption, μ, can now be defined by the following equation.

$$\mu = \frac{\log_e \frac{Io}{I}}{X}$$

Or, put in words, the absorption coefficient may be defined as the logarithm to the natural base of the absorption ratio defined by the thickness. The *mass absorption coefficient,* which is frequently used in the discussion of x-ray absorption, is simply this coefficient μ divided by the density of the absorber usually expressed in gm./cc., i. e.

$$\text{mass absorption coefficient} = \frac{\mu}{\rho}$$

(For those who may wish a simpler, though much less usable, statement of the meaning of the term absorption coefficient the following may be given: Imagine that the layer of absorbing material is so thin that only a small fraction, say 1 or 2 per cent, of the incident energy is absorbed. Let this fraction be denoted by p. Then, so long as p is very small, say, .01 or .02 we may say approximately

$$\mu = \frac{p}{X}$$

It should be pointed out that this latter equation cannot be used for larger values of p than .01 or .02. But it will serve to give some information as to the thickness of a layer of material necessary to absorb, say, one per cent of the incident energy. Thus, the value of $\frac{\mu}{\rho}$ for aluminum at a wave length of .2Å, i. e., at a wave length of .000000002 cm., is approximately .25. Since *P* for aluminum is 2.65, the value of μ is about .66. A thickness of aluminum to absorb 1 per cent of x-ray energy of wave length .2Å can be found by

this equation.

$$.66 = \frac{.01}{X}$$

from which X = .015 cm. i. e., at this particular wave length .015 cm. of aluminum will absorb one per cent. If, however, actual computations of the absorption are to be made for thicker layers of aluminum and of higher absorptions the log. formula above referred to must be used.)

If a solution of copper sulphate be held in front of an incandescent lamp it is well known that only the green and the blue in the spectrum of the incandescent lamp are transmitted, the yellow and red are absorbed. If, however, we hold in front of the incandescent lamp a solution of potassium bichloride the exact opposite is true, i. e., the blue and the green are absorbed, but the yellow and red are transmitted, and so far as we have been able to discover, there is no known relation between the absorption of potassium bichloride and of copper sulphate. Laws doubtless exist, but their complexity so far has defied discovery.

It is well known that carbon is a particularly opaque substance. Sulphur, likewise, is opaque, but if these two substances are combined in the atomic proportions of carbon disulphide a nearly colorless liquid results, transparent so far as visual observations go, to all wave lengths.

Fig. 2.

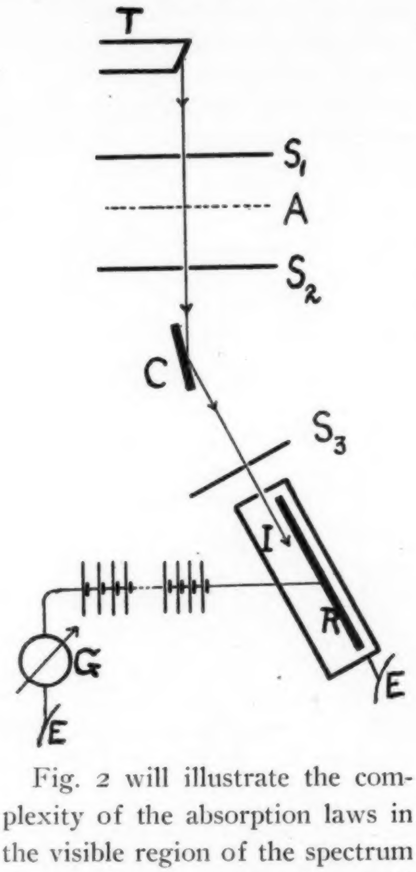


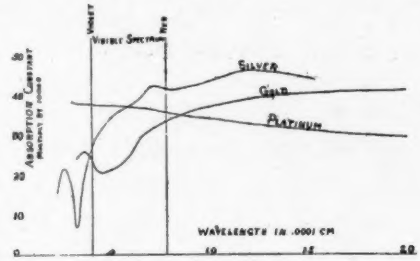
Fig. 2 will illustrate the complexity of the absorption laws in the visible region of the spectrum for the three elements, silver, gold and platinum. Although for ordinary purposes metals are considered opaque to ordinary light, yet by special means they can be prepared in films thin enough for absorption studies. The irregularity of the absorption of silver will be noted. It appears to be highly absorbent in the infra red region of the spectrum, its absorption decreases as one goes through the visible region from red to violet, which means that thin films of silver would be

bluish, and in the ultra violet there is a very narrow region of high transparency. It would be extremely difficult, if not impossible, to attempt to express the absorption constant of silver as a function of wave length. The same thing is true of gold and of platinum. And a glance at the curves will show that there is no apparent relationship between the absorption of these three elements. It would be impossible, for example, from a knowledge of the absorption curve for gold to predict that of silver and of platinum.

The above examples illustrate the fact that absorption laws in the visible and near-visible regions of the spectrum are exceedingly complex. When, however, we come to the x-ray region of the spectrum, although the same logarithmic law of absorption holds, we find instead of the chaos characteristic of the visible region perfect law and order in regard to the absorption of any one substance at various x-ray wave lengths, in regard to the absorption of atomic combinations of two substances, and in regard to the relation of one substance to that of another.

It was the privilege of the writer to spend some months at the Research Laboratory of the General Electric Co. at Schenectady in making some careful measurements of the absorption coefficients in the x-ray region of the spectrum of a number of substances at various wave lengths. The apparatus used for this work is diagramatically illustrated in Figure 3.

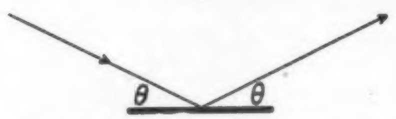
Fig. 3.



T represents the target of the x-ray tube, S_1 and S_2 are narrow slits in lead screens placed in line with the target. C is a thin crystal of NaCl. S_3, a third slit placed immediately in front of an ionization chamber I. This consists of a hollow cylinder of brass covered with lead with an opening over which a thin sheet of mica was fastened by sealing wax, the whole chamber being filled with some highly absorbent vapor such as methly-bromide. An insulated metal rod R was raised to a potential of two or three hundred volts, the other end of the battery being connected through a sensitive current measuring device G (in this case a very sensitive gold leaf electroscope) to earth. The brass case of the ionization chamber is also connected to earth.

It is well known that if a beam of x-rays strikes a natural crystal such as NaCl at an angle θ a part

Fig. 4



of that beam of wave length λ, given by the following equation, will be reflected at the same angle θ.

$$N\lambda = 2d \sin \theta$$

In this equation d is what is known as the grating contents of the crystal. In the case of NaCl it is equal to the distance in cm. between a Cl atom and its neighboring Na atoms. For NaCl this value of d is 2.814×10^{-8} cm. By turning the crystal C then at varying angles with respect to the incident beam it is possible to reflect into the ionization chamber any desired wave length. The crystal C and the ionization chamber I are mechanically connected in such a way that the chamber moves through twice the angle that the crystal does. The beam reflected from the crystal, therefore, always enters the chamber.

This beam of x-rays renders conducting the absorbing gas in the ionization chamber, the conducting power being greater the greater the intensity of the beam. It is obvious, then, that when the beam of x-rays is passing through the chamber the current measuring device G will register an electrical current. The magnitude of this current is taken as a measure of the magnitude of the x-ray beam.

This apparatus is patterned after the well known Bragg x-ray spectrometer. In order to measure absorption a layer of the material to be studied can be placed as shown by the dotted line A. Measurements of the current through the electroscope G are made respectively with and without the absorber in position A. This gives the quantities I and Io respectively referred to above. The thickness of the absorber is then measured and the coefficient of absorption determined from the logarithmic equation. This coefficient divided by the density of the substance gives the mass absorption coefficient which is plotted in all the curves hereafter referred to. It may be pointed out in passing that one of the serious difficulties encountered in this investigation was the accurate measurement of the thickness and density of the absorber. It was found, for example, extremely difficult to get homogeneous strips of such metals as molybdenum and silver thin enough for absorption work. The following curves will give quantitatively the absorption of several important substances in various regions of the spectrum and will also serve to illustrate the simplicity of x-ray absorption laws.

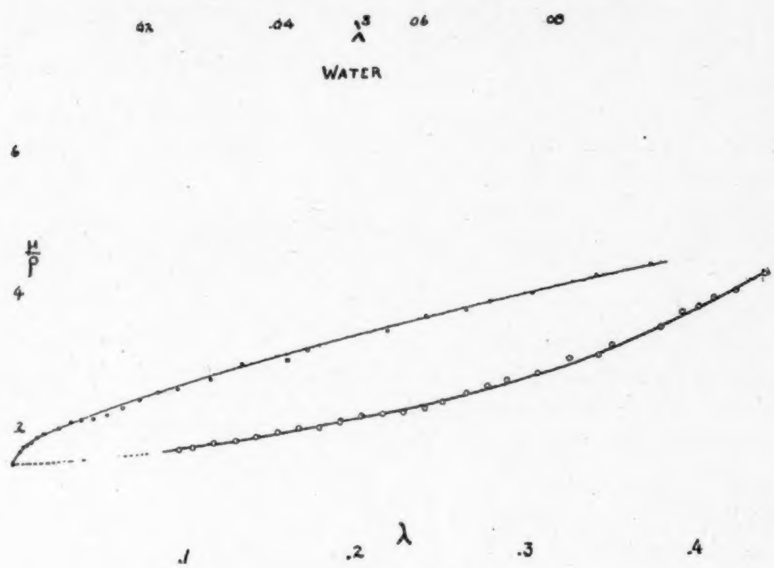


Fig. 5.

Fig. 5 (lower graph) shows the absorption curve for water from approximately .1Å to .45Å. In the first place it will be observed that this is a perfectly smooth curve, and if we were to follow it to still longer wave lengths it would follow the same regular curvature, the absorption getting greater and greater. It will also be observed that while there is some decrease in the absorption below .3Å this decrease is not much. It may be pointed out in passing in connection with the fact that there is comparatively little decrease in absorption below .2Å to .3Å there is little to be gained in the penetrating power of x-ray radiation by going to shorter wave lengths, i. e., to higher tube voltages or to lower equivalent spark gaps. A 10-inch spark gap, for example, filtered through several mm. of aluminum will give an equivalent radiation in the neighborhood of .2Å. Comparatively little in penetrating power would be gained by doubling the spark gap.

It may also be remarked in passing that whereas the value to which this absorption curve seems to approach as the wave length approaches zero is approximately $\frac{\mu}{\rho} = .16$, the value of $\frac{\mu}{\rho}$ for certain of the hard rays from radium C is .045. This means that the rays from radium C have a much higher penetrating power than any x-ray wave lengths that we have been able to produce. If we could follow this curve much lower than .1Å we might be able to observe the point at which it bends down to reach the absorption from these gamma waves

from radium C the wave length of which is not definitely known, but is of the order of .001Å to .01Å. The last point on the curve, however, was obtained with the greatest difficulty at a voltage impressed on the tube of approximately 145 K. V. (peak value) and as will be observed, there is no apparent tendency for a downward bend in this curve toward the radium absorption value. To reach this latter value we should have to be able to apply several million volts to the tube, which is, of course, at present out of the question. It is to be doubted whether this value of $\frac{\mu}{\rho}$ for water would decrease materially in going down as far as .06Å, which would correspond to a voltage of something like 250-300 K. V.

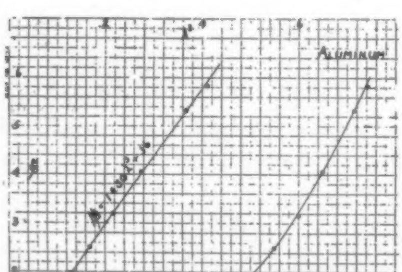


Fig. 6.

Fig 6 (lower curve) shows the absorption of aluminum up to .7Å. It will be noted first that this curve is smooth, of the same general shape as the absorption curve for water, but that the values of $\frac{\mu}{\rho}$ for corresponding wave lengths are larger for aluminum than for water. For example, at .4Å the value of $\frac{\mu}{\rho}$ for water is approximately .35, whereas the corresponding value for aluminum at .4Å is 1.05. The upper curve in Fig. 6 shows the result of plotting $\frac{\mu}{\rho}$ as a function of the cube of the wave length. The values of λ^3 are at the top of the figure. This graph is a straight line not going, however, quite through zero. We would express this fact by saying that "the mass absorption coefficient is a linear function of the cube of the wave length." The value of $\frac{\mu}{\rho}$ for aluminum at any wave length, at least up to approximately .8Å, can be found by substituting values of λ in the equation shown on this straight line graph, namely:

$$\frac{\mu}{\rho} = 14.30\ \lambda^3 + .16$$

Fig. 7.

Fig. 7 shows the corresponding values of $\frac{u}{\rho}$ for copper. The ordinates scale it is to be noticed has been reduced very much in order to get the curve on the sheet. The value of the absorption coefficient .4Å is 10. It will be noticed that at least up to .7Å the curve between $\frac{u}{\rho}$ and λ^3 is nearly straight, and up to this wave length $\frac{u}{\rho}$ for copper can be computed approximately from the formula

$$\frac{u}{\rho} = 147\,\lambda^3 + .5$$

Copper, it will be remembered, has a much higher atomic weight than aluminum; or we may say, the atomic number of aluminum is 13 and that of copper is 29.

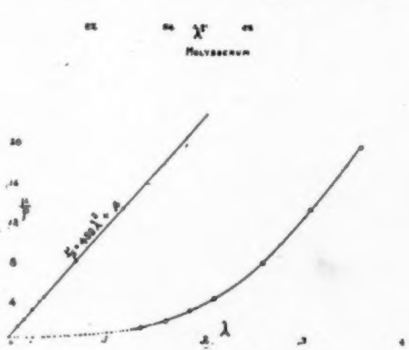


Fig 8.

Fig. 8 shows the absorption for molybdenum. Again it will be noted that the ordinates scale has been reduced and that the absorption of molybdenum is much greater than that of copper, although the two curves, the one where $\frac{u}{\rho}$ is plotted against wave length (lower curve) and the one where $\frac{u}{\rho}$ is plotted against λ^3 (upper curve), show the same characteristics as for copper. The value of $\frac{u}{\rho}$ for molybdenum at .4Å is not shown on this graph, but it is of the order of 35.0.

In order to show the absorption of molybdenum over a wider range of wave length Fig. 9 is shown.

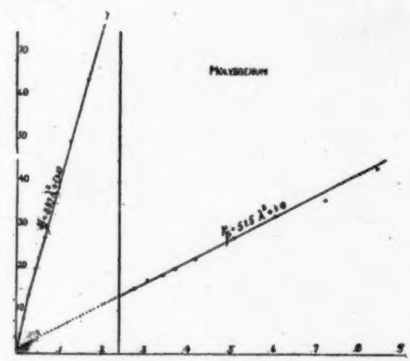


Fig. 9.

In this figure we have plotted the cube of the wave length against $\frac{u}{\rho}$. It will be remembered that as one passes along the wave length scale toward higher wave lengths the value of the absorption coefficient takes a sudden drop as one passes the region where the K series of lines begin. The vertical line shown on the λ^3 scale at about .24 represents the cube of the wave length of the shorter line in the K series of molybdenum. It is referred to in

the literature as the *critical K absorption frequency*. On the short wave length side of this curve it will be noted that the same linear relation between $\frac{u}{\rho}$ and the cube of the wave length holds at least approximately (there is to be noted a bend in the curve at a value of $\frac{u}{\rho} = 13.5$). On the long wave length side of this critical absorption frequency we find that the values of $\frac{u}{\rho}$ are much less. There has been a very sudden decrease in the absorption as one passes this critical limit. It is, however a matter of much theoretical interest to note that this graph for the longer wave lengths for which the equation

$$\frac{u}{\rho} = 51.5\ \lambda^3 + 1.0$$

has been determined when projected backward, cuts the axis of the absorption constant at apparently the same place as does the curve on the short wave length side.

This critical absorption limit occurs at shorter and shorter wave lengths for substances of a higher atomic number. This is shown by comparing Fig. 9 with Fig. 10, for silver. It is to be observed that for silver the same phenomena occurs as for molybdenum The cube of the critical absorp-

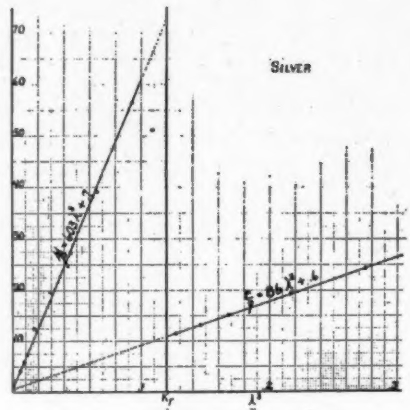


Fig. 10.

tion frequency, however, for silver occurs at 122Å as against .24Å for molybdenum. The atomic number of silver is 47 and that of molybdenum 42.

Fig. 11 shows the absorption data for lead. The curve marked "Pb" (abscissa scale below) shows the coefficient of absorption of lead from about .160Å up to .6Å, and the straight line shows the values of $\frac{u}{\rho}$ plotted against the cube of the wave length (upper scale). Lead being a substance of very high atomic number, its characteristic K absorption occurs at .158. The values here shown, therefore, are entirely on the long wave length side of the characteristic absorption. Yet, as in the case of silver and of molybdenum, there is a linear relation between $\frac{u}{\rho}$ and λ^3 over at least a portion of this length. It may be noted in passing over this range up to the characteristic

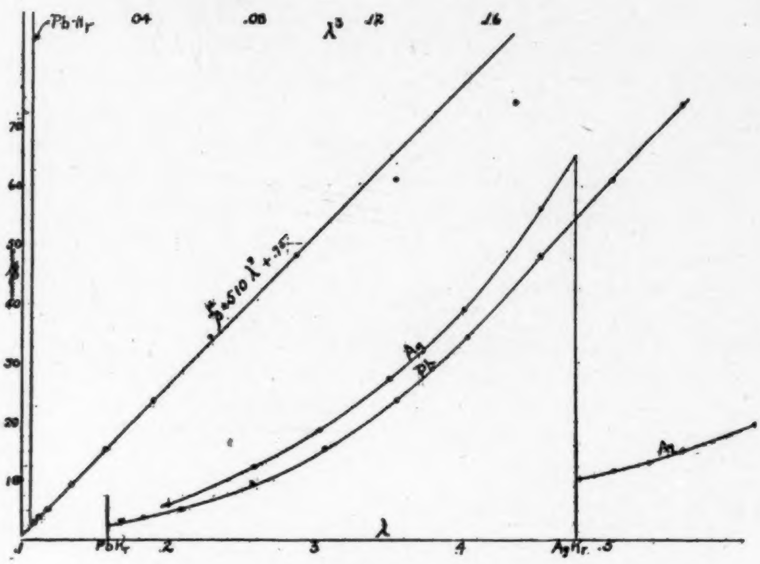


Fig. 11.

absorption of silver, which occurs at about .478, silver is a better absorber than lead. On reaching this latter wave length, however, as shown also in Fig. 10, the absorption of silver decreases very greatly, and beyond this point lead is the better absorber.

It is obvious, then, from an inspection of these curves that the absorption laws in the x-ray region of all the substances examined are very similar. And not only is this true, as, for any one substance, one states the absorption at various wave lengths, but it is also true as one goes from one substance to another. In referring, for example, to the linear relation between the absorption constant and the cube of the wave length the several equations have been written in the form

$$\frac{\mu}{\rho} = A\,\lambda^3 + B$$

The following table gives values of A for the several substances on the short wave length side of the K absorption limit.

Substance	Atomic Number	A
Al	13	14.45
Cu	29	147
Mo	42	450
Ag	47	603

If a curve be plotted between these values of A and the cube of the atomic number an approximately straight line results, showing that we can connect the absorption laws of any two substances by a single equation. In fact, we are now in a position to compute the mass absorption coefficients of all substances from Al to Ag, at least on the short

wave length side of the K absorption limit from a single equation. This fact will serve to emphasize the simplicity of absorption laws in the x-ray region.

It is not the purpose of the presen writer to point out the application of these laws to the various phases of medical practice. It is, however, obvious that the question of absorption is one of fundamental importance in medical diagnosis and treatment. It is a fundamental proposition that it is only absorbed energy which can produce any physical effect, and unless the energy absorbed has a frequency which is reasonably close to some characteristic frequency in the substance under investigation the effect of absorbed energy will be approximately the same for any wave length. Body tissues are made up in general of elements of low atomic weight): carbon, oxygen and hydrogen, in various chemical combinations. The characteristic x-ray frequencies of these substances are at far longer wave lengths than are used in medical practice. The writer wishes to predict, therefore, that when a study is made of the physiological effect of x-rays on living tissue, as a function *of wave length,* it will be found that the specific effect of, say, .1Å will not differ materially if at all from the specific effect for .2Å. By specific effect is here meant for *the same actual energy absorption*. By knowing, therefore, the composition of body tissues and these absorption laws, it is possible at least to take one step in the computation of the amount of energy which will be absorbed by any tissue at any depth. It should be clearly pointed out, however, that this does not take account of the question of scattered radiation, a part of which is, of course, absorbed. Scattered radiation renders the problem somewhat more complex.

Much more data is needed on the phenomena of scattered radiation, perhaps upon the absorption of substances of lower atomic number, and certainly of the specific effect of various x-ray wave lengths on tissue. Where would photography be, for example, if nothing were known of the effect of different colors of the spectrum on the photographic plate? Data of this kind may be difficult to get, but once it is obtained it will clear up a great many difficulties in the same way that an accurate knowledge of the nature of x-rays has cleared up many puzzles in x-ray phenomena. At least in studies of this kind we need in all probability not worry about the chemical composition of the substances, for, unlike the case of absorption of energy in the visual part of the spectrum, chemical combination of an element does not change its ability to absorb x-rays. If we know the absorption of carbon and of sulphur separately we can compute with corresponding accuracy the absorption of CS_2.

It is to be hoped that in the future there will be a much closer collaboration between the physicist and the student of the application of x-rays to medical sciences than there has been in the past. The subject of x-rays from the physical side is probably too involved for the average medical investigator to completely master for efficient use in his research, and it is certainly even more true that the reverse is the case with the physicist to attempt to master medical science. Further developments along this line must be by men representing each field, working in groups, each to supplement the other. It is the firm belief of the present writer that the large societies, such as the Radiological Society of North America, can do much to advance research along these lines.

Cornell University, December, '20

DISCUSSION

CHAIRMAN TYLER: We will now have this paper open for general discussion.

DOCTOR COOLIDGE: Mr. President, I should like to discuss the paper, but I would very much rather have Professor Richtmyer say a few words. It seems it might be helpful if he would put on the board just a rough outline sketch of the apparatus, so the men can see just how the points on these curves were obtained. It seems it might be helpful if he would illustrate so they would see the target of a tube and crystal, and how the rays come off, and how you pick up a particular wave length.

DOCTOR RICHTMYTR: I shall be glad to do so. Perhaps, in giving you a diagram of the apparatus, I might say just a word in regard to what is meant by the absorption constant.

Now, to those of you who remember your college algebra, shall I say, it is defined in this way. Suppose you have a slab of material through which a beam of x-rays or light or energy of any kind whatsoever is passing. The beam has a certain intensity before it strikes the slab of material, and it is reduced in intensity afterward.

We measure the intensity before it reaches the material and after it comes out, as shown in formula above.

DOCTOR COOLIDGE: I would like to call attention to one thing, how different that is from the sloppy method that has always been used, up to the time of Professor Richtmyer's work. Up to that time we had the x-ray tube up there, and we had the ionization chamber, and we had the different thicknesses of absorbers, but we had any mixture of x-rays, never twice alike.

It depended on a great many conditions, on the wave form of the circuit, and various other things, so that as people went ahead and measured the absorption coefficient of the rays up to this time, the thing had no meaning. It was useful for some purposes, but it had no clean-cut meaning.

You could not tell from your results what particular mixture of x-rays you had to give those results. You could fix up an infinite number of mixtures, all of which would give exactly the same result.

But now Professor Richtmyer, with these curves which he has shown us, has some clean-cut data on the transparency if you will, of different materials to x-rays of different kinds.

When I was in Germany recently, one of the German physicians, who was working in this field, was disappointed, indeed, to hear that Professor Richtmyer had done this work. The importance of it had been recognized there, but it had not been done. It is absolutely fundamental work. If we knew the wave form of the high tension current voltage that we are using on tubes, with the different types of apparatus, which are used, it would be possible, from Professor Richtmyer's data, to calculate everything there is in regard to absorption and scattering of radiations in the tissues of the body. There would be no need of further experimental work.

As a matter of fact, we lack sufficient data, at the minute, perhaps, on wave forms with the various machines you are using for that to be com-

pletely carried through, but you can make a great many useful applications of Professor Richtmyer's data today.

For example, if you admit certain things—I won't go into it too deeply, because I want to say a few words about it in my talk later—but if you admit certain things in connection with therapy, then you can say from Professor Richtmyer's data there is no use at all in trying to get rays more penetrating than to a certain point, because you can see from this data, that in the case of water, the tissue is going to be pretty nearly the same density. Of course, that the factor that causes the reduction in intensity of the x-ray beam as it penetrates the tissues is not absorption in the ordinary sense, but it is scattering, and his data shows you that scattering over a very wide range of penetrating powers of wave length is independent of the wave length. So after you get up to a certain penetrating power, there is no use at all in going further in that direction, so far as trying to increase, for example, in other language, trying to increase the ratio of depth dose to skin dose, because after you get to that point, the thing that causes the diminution of intensity is scattering, and you don't help that by going to more penetrating radiations.

I don't want to take too much time. I would much rather hear Professor Richtmyer.

MR. MORRISON: I have only just a question to ask. The absorption, you found, was proportional to the cube of the wave length. I did not get a chance to see that.

DOCTOR RICHTMYER: I shall not say "proportional to", but a "linear function of", which is a different thing.

Here is absorption, and here is wave length. If it is proportional to the cube of the wave length, it would start out at this point, which is not true. It starts out here.

MR. MORRISON: That is a constant?

DOCTOR RICHTMYER: The cube of the wave length multiplied by some constant, with this added, gives you the absorption.

CHAIRMAN TYLER: Is there any further discussion?

DOCTOR RICHTMYER: Thank you, Mr. Chairman. I might add just one more thing. Again, from a physical standpoint, it is only absorbed energy which can produce a physical or a physiological effect. You know that from your actual experience with the optical spectrum. If you put out two beakers in the sunshine, one clear water, and one with India ink, the one with India ink in the water will warm more rapidly, because it absorbs more rapidly.

So from this data we can get some notion of the amount of the absorbed energy, and it is only the absorbed part of the energy that can possibly produce a physical or a physiological or a chemical effect. (Applause)

Roentgenographic Diagnosis of a Three Months Pregnancy

F. H. Kuegle, M. D., Sioux City, Iowa.

THE clinical signs and symptoms of pregnancy are, as a rule, so clear cut that the obstetrician has no difficulty in establishing a diagnosis by the end of the third month of gestation. There is, however an occasional case in which the physical findings leave the examiner in considerable doubt so that no definite conclusion can be reached. This is particularly true in young and vigorous primiparae in whom there is no relaxation or softening of the generative organs and in whom vaginismus is excited by examination.

The writer was recently called upon to make an x-ray examination of such a case with a view of

definitely reaching a diagnosis. This was done with considerable misgivings, since no report in the literature of a successful, roentgenographic diagnosis of a three-months pregnancy could be recalled.

In this case, the history is so clear that there is little doubt that the pregnancy is under three months. This is borne out by the size and shape of the fetal shadow on the roentgenogram and by the fact that it lies low in the true pelvis. It is in the upright posture, measures 2¾ inches vertically and 1¼ inches transversely. The two femora are clearly shown, as are also the umbilical cord and the placental attachment.

The technic of the exposure was as follows. A duplitized film, double screen and 30 MA. radiator type, Coolidge tube were used. The tube was energized with 25 MA. current at a voltage of 42,000, which necessitated a relatively long exposure. By following this technic, the writer believes that there should be no difficulty in showing a three months' pregnancy in a high percentage of cases.

What Say?

A man by the name of Sprague wrote a beautiful story in a recent issue of the Saturday Evening Post in which he had a whole lot to say about the "stand-off system" in big business—from the angle of too many office boys and secretarial artists.

But he missed the big story—one that has all the merits of truth as well as the freedom of fiction. The fact is, business pretty generally has been on a "stand-off" basis for quite some time. And it seems yet to be a case of who can stand the other fellow off longer.

Any practicing physician or surgeon will testify to these facts.

The Importance of the Correlation by the Roentgenologist of the Clinical and Roentgen Ray Findings in Pathological Conditions.

SAMUEL B. CHILDS, M. D., DENVER, COLO.

IT MAY seem superfluous to state that in a very large number of the cases referred to the roentgenologist, accurate and reliable information can be furnished from the x-ray evidence alone. This class of cases does not engage our attention in this paper. In the obscure or doubtful cases, however, the writer has found that the evidence obtained from the personal examination and the clinical history of the patient frequently adds materially to the ability of the roentgenologist to correctly interpret the x-ray findings.

It is taken for granted that all cases are referred to the roentgenologist solely for the benefit of the patient and for the greatest assistance that can be rendered in making an accurate diagnosis. On this hypothesis the title of this paper is based and any deductions from the paper apply especially to those roentgenologists who do not limit their x-ray diagnosis to some particular field.

Let us for a moment consider the status of the roentgenologist at the present time. Are there not some who attempt to make a diagnosis in all pathological conditions from the x-ray evidence alone? If their opinion is substantiated by conclusive proof their skill in interpretation is enviable, but the writer never expects to reach that degree of efficiency, for his observation is that the more closely the roentgenologist traces his findings to the operating table, the more he is convinced that several conditions can produce x-ray evidence so similar, that in one case, a certain disease is demonstrated, while in another, apparently the same x-ray condition is detected, but a different lesion is found to produce it. This applies not only to the diagnosis of certain pathological conditions in the softer structures of the body, but also in the denser, for some forms of bone disease are extremely difficult to differentiate from the x-ray evidence alone. If these observations are correct we need additional data not furnished by the x-ray to aid us in obtaining greater accuracy in diagnosis.

We are also aware that there is a comparatively small number of practitioners who presume to make their own deductions from the plates made by a roentgenologist not employed by them as an assistant. This admits of two in-

ferences, either the roentgenologist is considered incapable of correctly interpreting the x-ray evidence or else the physician or surgeon by the aid of his knowledge of the clinical findings in the case feels more competent to make a correct diagnosis by correlating the combined evidence. In either case, the roentgenologist is at fault by his failure to qualify himself so that he can make a more accurate diagnosis in a given number of cases than any physician or surgeon who devotes only a comparatively small part of his time to the study of x-ray data. By his failure o qualify himself, the roentgenologist is considered a laboratory assistant.

Is it not true that some of us are subject to just criticism in many instances for attempting to read too much into our plates? Do we devote sufficient time and study to anatomy, clinical medicine and clinical surgery? Should not the experience we have acquired in these lines give us a more comprehensive view of the problem in obscure clinical pathology before we attempt their diagnosis by the x-ray alone? Do we realize the great responsibility assumed by the roentgenologist in diagnosis and do we thoroughly equip ourselves by adequate preparation to meet this responsibility? If so, then only can we expect to have the judgment necessary for correct interpretation, which will entitle us to be considered as diagnosticians or consultants and not laboratory assistants. In presenting a subject such as indicated by the title of this paper, the writer asks your indulgence for any personal allusions as it is believed that the citation of a few cases will illustrate the thoughts intended to be conveyed better than any other means.

Case I. A few years ago a patient was sent from an eastern city for tuberculosis of the lungs; this diagnosis was made following an x-ray examination of the chest. The case was referred to the writer and upon the chest plate, in the right lung just below the hilus in the line of the descending bronchus, was a dense circumscribed shadow not unlike that so frequently found in calcified tuberculous nodules in this area, except for its unusual shape. There were also changes in the base of this lung which simulated the appearance of tuberculosis. The patient's history disclosed the fact that a number of her teeth had been removed under a general anaesthetic some time prior to her being sent to Colorado, and that upon regaining consciousness there was a cough which had persisted and been her main symptom. No cough was present prior to the operation described. With this history the dense nodule was readily identified as a molar tooth and the changes noted at the base were considered secondary to the presence of the foreign body. The

tooth was subsequently removed and the patient speedily regained her health. The error in the original diagnosis was evidently due to the failure to obtain the clinical history.

Case II. A man thirty years of age was referred from a distant town in Colorado. He brought a note from his physician, stating that carcinoma of the stomach was suspected. The patient presented a marked cachexia, experienced great difficulty in retaining any kind of food, had lost about thirty pounds in weight, and was easily exhausted. Our examination failed to disclose any organic disease of the gastro-intestinal tract and pernicious anemia was suspected by exclusion. It was suggested that the patient be referred to a laboratory man for a blood examination. This was consented to and the typical picture of the disease suspected was found. In this case, the diagnosis was made from the correlation of the clinical and laboratory evidence and the negative x-ray findings.

In the gastro-intestinal examinations of people past middle life, the writer has been impressed with the fact that various abdominal symptoms are alleged that simulate closely those present in an organic lesion of the viscera and yet not sufficient evidence is found at the x-ray examination to warrant the existence of those symptoms. There is evidently an organic basis for the symptoms as the situation always seems serious to the patient. We have also noted that the x-ray evidence disclosed either cardio vascular disease or else a high blood pressure record was found, generally with evidence of cardiac insufficiency. No attempt is made to give an accurate explanation of the abdominal symptoms in these cases, but a plausible one seems to be that certain pathological changes in the heart and aorta produce symptoms which are referred to the gastro-intestinal tract due to the fact that the nerve supply of of each is derived from the same trunk of the sympathetic system or possibly these symptoms are caused by an atheromatous condition of some of the arteries within the abdominal cavity.

Case III. A man of fifty-eight years of age was referred with a probable diagnosis of gastric ulcer. He had many of the typical symptoms of this disease, was extremely weak, prostrated and short of breath, but nothing from our examination was found to indicate disease of the stomach, or furnish evidence of any disease of the alimentary tract. The heart and aortic shadows showed evidence of cardio vascular changes, although the heart shadow was only moderately enlarged. From the correlation of the clinical symptoms, mainly shortness of breath and prostration, the x-ray evidence from the

heart and aorta, an opinion was given the attending physician that the stomach symptoms were probably due to cardio vascular disease. At the time of our examination the apex of the heart was just outside the nipple line. Subsequently I was informed that in a few days the apex beat was still more to the left of the nipple and the area of heart dullness was considerably increased. In about two weeks this area had markedly increased and the patient died from cardiac dilatation.

A correlation of all the evidence at our disposal is considered particularly advisable in a case that has received an injury, while in the employ of a corporation or an individual, for the question of compensation for damages is always to be considered a possibility and fairness to both sides frequently demands that our opinion be based upon such correlation. The following case is a good example.

Case IV. A young man who had been in the employ of a railroad for a few days alleged that while engaged in construction work, he had slipped and fallen, doubling his left knee under him, and as a result, had sustained a disabling injury. When he was brought to the hospital two days after the injury, adhesive strips covered the greater part of the joint and over these was a bandage. After the dressings were removed some swelling was apparent about the joint but the general appearance of the knee did not indicate the probability that severe traumatism had produced the symptoms of pain, local tenderness and inability to use the joint of which the patient complained. The x-ray demonstrated that the patella was dislocated to the outer side of the external condyle, but the amount of distention of the joint generally found in a recent traumatic dislocation was not detected. By correlating all the evidence, despite the alleged symptoms, an opinion was given that although the patella was dislocated, it was believed that this dislocation was not caused by his injury. When the patient was informed that the disability in his knee was not due to his recent accident, he admitted that he had been able for quite a time, frequently, to displace this patella at will, and that he could also, occasionally, do the same with the patella in his other knee. Furthermore, he stated that he, with the aid of a young man about his own age, who had had some experience in the army in applying surgical dressings, had applied the adhesive strips and the bandage. He was discharged from the hospital and immediately returned to work.

In this connection it is well to call your attention to a condition which has often confronted all of us, namely, the examination of a laborer who has previously sus-

tained an injury to the spine or some joint like the hip, in which are demonstrated bone changes, ordinarily considered typical of osteo-arthritis. Let me call to your notice the changes in the bony structure, particularly noticeable in certain parts of the body, due to pressure from occupation which are purely physiological or certain senile changes that take place in joints without actual disease in the joints as a starting point. This subject was comprehensively covered by Mr. W. Arbuthnot Lane in articles which were published in the Transactions of the Pathological Society of London in 1886, and in Guy's Hospital reports of the same year. Referring to the bone changes in patients under the above classes, Mr. Lane states "All these changes have been regarded as the products of the disease rheumatoid arthritis. I think I have brought sufficient evidence to show that they are the results of the transmission of pressure."

From the x-ray examination it is considered difficult, if not impossible, to differentiate these bone changes due to pressure from traumatic or pathological osteo-arthritis, so similar if not identical is the appearance. Hence in these conditions it is extremely important to obtain all the information possible about the presence of any bone changes in joints other than those in question, as well as the clinical history and previous occupation of the patient before we ascribe such changes to traumatism. The medico-legal question of the effect of traumatism upon these pressure changes above referred to is an entirely different matter.

The writer could cite cases not only in illustration of the type above referred to but also of many other conditions of the body, in which valuable assistance has been rendered in the interpretation of our findings by correlating other evidence, but time does not permit.

My conclusions are stated in two sentences:

Accuracy in the diagnosis of obscure pathological lesions demands the correlation of clinical and x-ray evidence.

The sooner the roentgenologist realizes this the sooner will he attain his proper standing as a consultant.

Speaking of Education

TALKING about headlocks, strangle holds and scissors—judging from newspaper accounts, the midwest farmer would like to know in what banks Lewis and Stecher got their training.

X-Ray Treatment of Leukaemia

G. E. RICHARDS, M. D.

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Director of Department of Radiology, Toronto General Hospital.

THE chief object in view in bringing forward this subject at the present time is the conviction that roentgenologists generally do not take a strong enough position regarding the value of roentgen therapy in luekæmia, and secondly, because of the fact that one finds the profession at large either ignorant of, or at least not convinced of the fact that in roentgen-ray therapy and radium, we possess by far the most successful therapeutic procedure so far advanced for the treatment of this disease.

The general opinion seems to be that a diagnosis of leukæmia is tantamount to a death sentence within one or two years, and since nothing can be done, the patient is given a prescription containing arsenic, and advised to put his affairs rapidly in order.

While I am forced to admit that our best efforts have so far failed to alter the essentially fatal nature of the disease, and to agree that in consequence the treatment of such cases is depressing, yet there is the other side of the picture, namely, the fact that we can restore many of these people to a relatively normal state of health for long periods, and by careful management preserve for them a number of years of comparative comfort. These results we are all familiar with, but have we sufficiently emphasized to the profession just how far superior the results may be to other forms of treatment?

The treatment of the disease really resolves itself into a rather rigid management of the patient's life, and in our experience of twenty-two recent cases, several facts have so forcibly impressed themselves upon me that I thought it might be of value to bring them up for discussion.

In treating the group of cases here reported, we have made an effort to solve the problem of correct technique by reasoning from two of the commonly accepted theories as to the etiology of the disease.

It is admitted that until we have more definite information as to the cause or causes, much or all of our work must be empirical as in the past. But two fairly definite lines of thought present themselves as a present guide, and in my belief these involve entirely different conclusions, and modes of treatment. This is written also with an intimate knowledge of the excellent writings of Pancoast and others, and more in the hope

of assisting in arriving at some recognized standard procedure than in the belief that anything very new or original is being added to the literature.

ETIOLOGY

(1) In the first case the disease has been compared to sarcoma, and thought to be essentially a malignant manifestation of the blood and blood-forming organs.

If we adopt this view our treatment must take the form of intensive irradiation using a high spark-gap, heavy filtrations, etc.

(2) The second view would regard the process as primarily and essentially a hyperplasia of the spleen and bone-marrow, not in itself malignant though productive of changes incompatible with life. The fact of the hyperplasia of course we know to be present in both instances, but its significance is considerably altered in the two theories.

We therefore, decided several years ago to try out the two theories, basing our technique upon these two conceptions, and although the series of cases is too small to justify a generalization, we have obtained so much better results from following the second line of reasoning, as to lead to the belief that it is more than coincidence.

We believe that we may logically draw an anology between our therapy in disease of the thyroid and the present case. In the thyroid our best results are obtained in the active hyperplasias with great toxicity. And here we select a ray, the purpose of which is to depress the activity of the cell, and inhibit cell division, and so cause a return to normal function. The analogy may be pursued in Hodgkin's disease, except that in the latter it seems probable that we are confronted with at least two distinct types of the disease, depending upon certain biologic differences in the lymphoid tissue, not as yet adequately described. Of these, one will respond to irradiation, and the other is almost entirely unaffected. This very observation, if it is an accurate one, leads too far for the purpose of the present paper, but may account for failures in certain forms of leukæmia associated with extensive involvement of lymphoid tissues generally.

The whole point in the argument is simply this: Our results would lead us to the conclusion that better results are to be obtained by a technique designed to depress the function of cells which are in a condition of hyperplasia than by one designed for the destruction of cells. The use of terrific irradiation with high spark-gap and heavy filtration will result in extreme fibrosis of the spleen, and other changes of a permanent and disadvantageous nature in the medulla of bones, and will not give as good ultimate results as a less severe procedure.

What then may be regarded as the procedure from which we may expect the maximum of results in the average case?

After very careful study of all the available literature upon the subject, and in view of our own experience, we have adopted the following as a routine, which is modified slightly to suit individual cases, but which is adhered to fairly closely nevertheless.

The irradiation is commenced upon the spleen using areas four inches square, and limiting the treatment to one area each day.

This serves a double purpose—

(1) It almost entirely eliminates the danger of nausea and depression due to the treatment, and,

(2) It brings the patient gradually under the influence of the ray and the altered conditions resulting therefrom.

The treatments are continued over the splenic area daily until sufficient have been given to entirely cover it according to the usual method of deep therapy The long bones are then exposed in rotation, still adhering to one area of the same size each day.

The other factors we believe to be of great importance. The spark-gap is six inches or possibly seven inches,—never more. Filtration is 2 mm. of aluminum, and through this we deliver 25 milliampere minutes at 10 inches distance.

The result is that the patient receives such an exposure each day for about two weeks, and receives a constant effect, both local and constitutional during the whole of that time.

A blood count is made at the end of two weeks from the date of the last treatment, and upon that basis the necessity of further treatment is determined. If the count has been considerably reduced, but is not normal, the same series is repeated in exactly the same order. And this is continued until the white count reaches ten or twelve thousand, when all treatment is discontinued for the time. Blood counts are continued every two weeks until the count begins to rise, and the entire series is then again repeated, even though the elevation in the count had been slight. In the average case, which is not extreme or far advanced, three such series have been sufficient to stabilize the blood picture at a point which could be said to be normal for leukæmia.

As soon as the blood appears to be stationary, the interval between blood counts may be increased to one month, but *these should be insisted upon at monthly intervals during the remainder of that patient's life.*

This is one of the two outstanding lessons which have been impressed by the present series of cases. Of nine cases treated by the above routine, six are still alive after three years, and of these four have practically normal

blood pictures, and the spleen is not palpable in any of them. The three who died all departed from the routine in some particular. In one of these the patient's husband had influenza, during which she nursed him for two months, and then took an additional month's holiday. At the end of that time her blood count was up, myelocytes which had been absent had reappeared, and the spleen was again enlarged, extending down about two inches below the costal margin.

Another patient whose blood seemed stationary, went away for the summer, and remained three months. When he returned the spleen had again enlarged, and the count was up with very active cell changes.

The second point I emphasize, naturally follows the first. If the spleen has been enlarged, and has receded behind the costal margin so as to be nonpalpable, and is then allowed to enlarge, the chance of it again responding to radiation is very slight. In one or two cases I have seen it do so, but in the majority it becomes hard, fibosed, refuses to respond to further treatment, and this may be accepted as a condition which is certainly hopeless. It is, therefore, our duty to so carefully guard our patient that the spleen once having disappeared shall remain there. And this is only done by frequent blood examinations. By doing so I am convinced we can prolong the lives of our patients much longer than has been possible in the past or is possible at present by any other method of treatment.

Similar results are no doubt obtainable by radium, but it is easier to make the application over the larger area by means of x-rays. In addition to this, the majority of the cases one sees treated by radium have palpable spleens, which are already fibrous and hard. This I believe may be prevented by less intensive x-ray dosage, and its prevention is a very great consideration.

As to the use of arsenical preparations, we have thought there was a better response in those cases in whom arsenic was present in the blood at the time the treatment was being given, and have continued it accordingly. Benzol has not been used in any of the present series of cases.

Injection of the Sphenoid Sinuses With a Suspension of Barium Sulphate

MAXIMILIAN J. HUBENY, M. D., CHICAGO, ILL.

THE roentgen method of examination has been utilized to a very extensive degree in several important fields such as urology, gastro-enterology, and pulmonary diagnosis, by ingestion or injection of opaque substances. Necessarily the anatomical or pathological conditions make such a procedure possible.

Figures I. to X., inclusive, represent different views of same patient, in which a unilateral injection was made.

Fig. I.—Case No. 19388—Lateral radiogram before injection.

Fig. II.—Lateral radiogram after injection.

Fig. III.—Case No. 19388—Posterio-anterior radiogram before injection.

Fig. IV.—Postero-anterior radiogram after injection.

Through the kind co-operation of Dr. John A. Cavanaugh, the examination of the sphenoid sinuses was undertaken for the purpose of showing their size, shape and position, also if possible to

note the proximity of adjoining structures and determine the cause of neighborhood symptoms.

The sphenoid sinuses occupy the body of the sphenoid bone, being situated directly behind the ethmoid capsule at the posterior and superior portion of the nasal cavities. In the fully developed stage the sphenoid sinus represents a cavity which may be regular, irregular, large or small, depending upon the amount of re-absorption of spongy bone which has occurred. The sinuses are separated from one another by a septum, which, like that of the frontal sinuses, may be considered as a continuation of the nasal septum. Along the anterior attachment

Fig. V.—Case No. 19388—Right oblique position before injection.

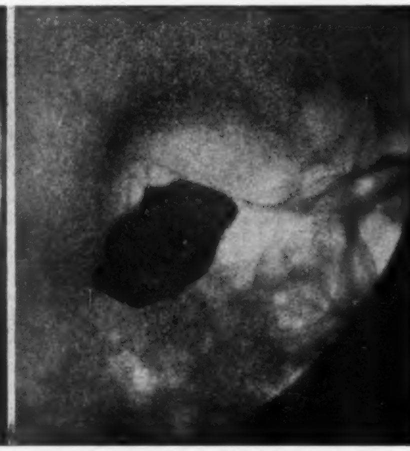

Fig. VI.—Right oblique position after injection.

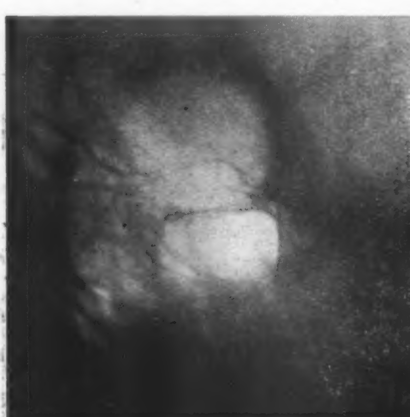

Fig. VII.—Case No. 19388—Left oblique position before injection.

Fig. VIII.—Left oblique position after injection.

this septum is usually in the median line, but as it extends backward, it frequently deviates to one side, thus making one side larger than its fellow. Complete absence of this partition, throwing both sinuses into one large cavity with a single ostium, has also been observed.

(1) deviations of an inter-sinus septum, (2) over-reabsorption, causing unnatural enlargement of the cavity and prolongations, (3) over-extension of the posterior ethmoidal cells.

Under deviations of the septum we have inequalities in the size and shape of the two sinuses. This

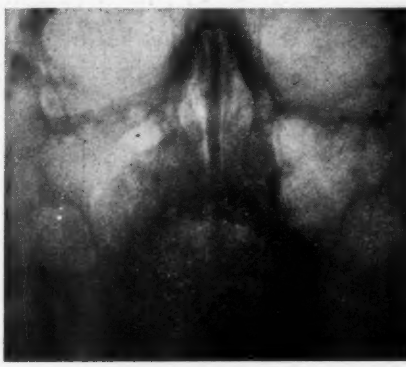

Fig. IX.—Case No. 19388—Water's position before injection.

Fig. X.—Water's position after injection.

The ostium of the sinus is situated in the nasal portion of the wall, usually in the upper third and seldom below the median line. Whether it lies close to the nasal septum appears to depend largely upon the depth of the spheno-ethmoidal recess, as the deeper the recess the further away from the median line it seems to find its location. The position of the ostium in relation to the sinus floor is similar to that found with the maxillary, namely, in a very unfavorable position for drainage.

There are many peculiar cell formations and anomalies exhibited by the development of the sphenoid. These may be due to

may be slight and confined to the posterior portion or be so great as to practically throw both sinuses into one large cavity, with a small cell representing the other sinus, in the anterior portion. Ordinarily the curvature is in the antero-posterior direction, but it sometimes also takes on a lateral deviation, thus placing one sinus in relation to the sella turcica, both the cavernous sinuses and both the optic nerves. Incomplete septa are frequently formed on the posterior sinus wall. These sometimes are so large as to lead one to think of a triple sinus.

Over-reabsorption often causes the sinus to be prolonged in vari-

ous directions (a) into the lesser wings and clinoid processes, (b) into the antero-inferior angle; (c) into the pterygoid processes.

When re-absorption extends into the lesser wings and clinoid processes, the sinus encroaches upon the optic nerve, often to such an extent that the nerve comes to lie almost within the sinus cavity. The importance of this anatomical configuration cannot be over esti-

Fig. XI.—Case No. 19401—Postero-anterior radiogram with left sphenoid injected.

mated, especially in connection with ophthalmic complications resulting from infection of the sinus mucosa.

When the sinus extends into the antero-inferior angle, the maxillary sinus is in direct relation with the sphenoid, only a thin partition of bone separating the two cavities.

This formation is rare, but when present is particularly favorable for operation on the sphenoid via the maxillary sinus route.

Re-absorption into the pterygoid processes causes circumscribed depression to be formed in the floor of the sinus, thereby favoring stagnation and poor lavage in case of suppuration.

Over-extension of the posterior ethmoidal cell. Occasionally the sphenoid sinus is poorly developed; a posterior ethmoidal cell

pushing it downward and backward and occupying the place where the sphenoid is normally situated, thereby forming a spheno-ethmoidal cell. Under these circumstances the posterior ethmoid cell is then in relation to the optic chiasm and pituitary body. Not infrequently this cell is in relation to the splenoid sinus of the opposite side, and if diseased, it could easily communicate the infection to this cavity.

Fig. XII.—Case No. 19401—Left oblique position after injection of left sphenoid.

From the above, it will readily be appreciated that the sphenoidal sinuses are difficult to portray with a fair degree of certainty, even though a comprehensive x-ray study is made. It is not intimated that the following should be used as a routine diagnostic measure, but in cases where the symptoms are obscure, or treatment unresponsive or if the sinus is suspected of being in close relationship to the surrounding structure.

Not enough cases have been examined in this manner to draw comprehensive conclusions, but it is hoped that the feasability, ease of application and apparent harmlessness will stimulate others to apply this method of examination in selected instances.

Technique: The opaque medium (barium sulphate suspended in a solution of malted milk) is injected into the ostium, after the latter has been dilated and anesthetized, until over-flow exists. Then mop away any solution outside of the cavity and introduce cotton to prevent the liquid from flowing out, after which the necessary plates are taken. The following positions were usually employed:

(a) Stereoscopic postero-anterior.

(b) Two obliques (Pfahler's views).

(c) Lateral (stereoscopic where possible).

After the radiograms have been taken, the sinuses are drained and irrigated with sterile water. So far no untoward results have been encountered.

Bibliography—

Fig. XIV.—Case No. 19401—Lateral position after injection.

Fig. XIII.—Case No. 19401—Right oblique position after injection of left sphenoid.

Fig. XV.—Case No. 19453—Postero-anterior position after injection of right sphenoid.

Fig. XVI.—Case No. 19453—Right oblique position.

Fig. XVII.—Case No. 19453—Left oblique position.

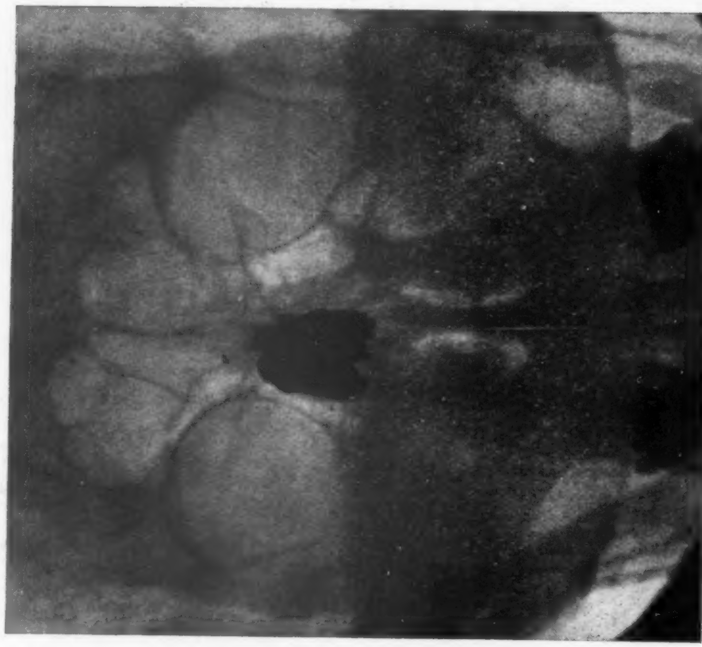

Fig. XIX.—Case No. 19453—Posterior-anterior position with left sphenoid injected.

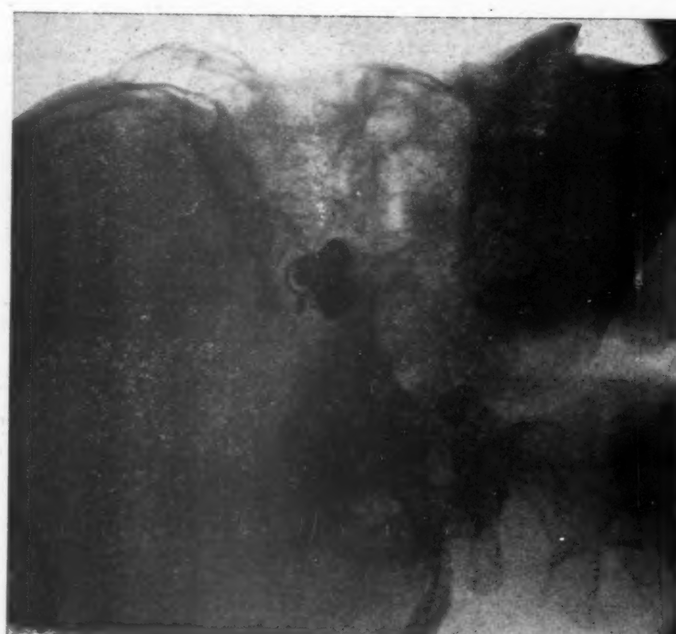

Fig. XVIII—Case No. 19453—Left lateral position.

Fig. XX.—Case No. 19451—Right oblique position.

Fig. XXI.—Case No. 19451—Left Oblique position.

Fig. XXIII.—Case No. 20717—Probes in ostia of both sphenoids before injection.

Fig. XXII.—Case No. 20111—Both sphenoids injected.

Fig. XXIV.—Case No. 20717—Posterior-anterior position with both sphenoids injected.

Fig. XXV.—Case No. 20717—Left oblique position.

Fig. XXVI.—Case No. 20717—Right oblique position.

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Our Policy

WHEN, as sometimes happens, a careful observer of current affairs turns the pages of a scientific publication such as this, he may argue about the plan of mechanical production, or the technique of the general scheme of things, but if he is at all honest with himself, if he applies a few of the principles experience has taught many of us to use as a measure of our fellowmen's conduct, he will instantly admit that the thoughts, the ideas, and the opinions expressed are those of men animated by high purpose, by men whose constant urge is to add something really worth while to the sum total of practical scientific knowledge concerning the uses and benefits of Radiology. He will also admit, if he examines the pages of this particular publication at all carefully that more than all else, the men who delve into the hidden mysteries of the science of x-ray are human as he is human.

By way of preface, it is perhaps well to say that this is not a new publication. Its clothes—its general appearance has been altered somewhat in response to the breath of Spring, which has blown upon our cheeks so kindly during the past few days when we were walking in the shadow of the proverbial ground hog. All we are trying to do is to continue a very estimable undertaking, set in motion several years ago by some of the early members of The Radiological Society of North America. We are grateful to them because we are enjoying some of the benefits of that peculiar foresight and fine fortitude which was sufficient justification for their undertaking, and which enabled them to look far enough into the future to see the importance to the Society, to the medical profession generally, and to the public at large of a journal devoted exclusively to the advancement of Radiology.

Radiology is still in its infancy, so far as its uses and benefits have been discovered and applied. What shall we say of it, then, when those pioneers of the profession to whom we owe such a sensible obligation, conceived the Journal of Radiology as a medium for the interchange of ideas? How shall we compass their vision and their understanding? How shall we compensate their efforts, except in the one and only way they would have us compensate them, that is, by making The Journal a reproduction of the high ideals which sustained them in all their arduous labors?

Time is exceedingly fleet of foot. The problems of today are not those of yesterday. Consequently, there is an obvious value in this publication for those more active brains of the profession, those men who are constantly striving to co-ordinate and harmonize the best there is in Radiology with the accumulated knowl-

edge of the centuries concerning the practice of medicine and surgery.

In this way only can we justify our claims on the time and efforts of those leaders of the profession, who, because they realize a deep sense of social duty, respond to that constant urge of scientific development and progress which decrees that their individual knowledge and experience shall become public knowledge and experience.

On behalf of those men who have so generously supported The Journal in times past, those who are now carrying its burdens, and those who will assume its responsibilities in future, we want to say that they have given and will continue to give the most recent thought on the subject of Radiology. They are men and women who stand in the forefront. Each name is a guarantee that what they have written is worth reading and that it is the product of mature thought. With no apology, because of their contributions The Journal has been and will contiue to be a well-balanced composite of the meditated opinions of the greatest specialists.

From all of which the policy and purpose of The Journal may be inferred. Let every man interested in Radiology, in any sense whatever, appreciate the increasing purpose which controls our every effort and give The Journal the consideration and support it deserves as an instrumentality devoted to the common good.

We believe that Radiology stands just now on the verge of an era of great accomplishment. Wherefore, we bespeak your tolerance if occasionally we seem so small of stature in a big field—we hope you will appreciate the thousand petty distractions which sometimes well-nigh overwhelm even those men who see big things in the future and endeavor by their greatness of view to prepare us for the full fruition of our opportunity.

We make no claim of belonging to that class. We are glad that charity permits us to pick up the crumbs which fall from the table at which master minds alternately feast and diet. But we are mindful, nevertheless, that each of us can and should add his mite so that our combined purpose will ultimately be achieved, and our ideals be thereby incarnated.

Summer Meeting

THE program for the Summer Meeting, which will be held at Hotel Lennox, at Boston, June 3rd and 4th, is well under way and promises some mighty fine things of an instructive nature.

Those contemplating attendance should make hotel reservations immediately by writing direct to the management. This admonition is worth considering, because the management informs us its accommodations are almost entirely engaged even at this early day.

So if you plan on going to Boston in June—and you cannot afford to do anything else—telegraph or write now for your rooms.

The Radiologist A Consultant

THE development of radiology during the past few years has been so rapid that there are many problems which are not quite definitely settled. Amongst these problems is the position of the radiologist in the medical profession.

The specialty of radiology is really such a broad one, touching every phase of medicine, that it necessitates the most thorough training in the fundamental subjects of medicine. It really means that the radiologist must be as well equipped as the internest in order to make correct interpretation of the findings in individual cases. The paper by Dr. S. B. Childs, published

in this issue, brings to our attention this fundamental necessity. It is our opinion that radiologists themselves can really elevate the profession by preparing themselves, as Dr. Childs has suggested. The man who does not strive toward this kind of practice will really in time become little short of a technician. For years we have felt the necessity of this kind of preparation so that in our teaching we have used the following postulates:

The x-ray shows only three things—
1. **Change in density.**
2. **Change in form.**
3. **Change in movability.**

The interpretation of these changes must be based upon a knowledge of—
1. **Anatomy.**
2. **Physiology.**
3. **Pathology.**

Combined with—
1. **The clinical history.**
2. **The physical findings.**
3. **The laboratory findings.**

The man who is content to make only the x-ray picture follows the path of least resistance. He can never expect to rise to the position of a medical consultant.

Throughout the entire course which is given to medical students we constantly impress upon them the necessity of correlating all of the findings about the patient, using the x-ray findings along with the history, the clinical findings and the laboratory findings.

Right on the Nose

SPEAKING of the work of the League of Nations at Geneva, M. Viviani, head of the French delegation, said:

"We would accomplish little, if in taking steps to prevent future wars, we overlooked the almost equal danger of Bolshevism. * * *

The only preventative is *International Economic Harmony,* which must be accomplished throughout the world as it is now accomplished by individual states."

Thus, we have another straw pointing the direction toward which public opinion is blowing, and likewise, we have another indication that if the United States desires to maintain a place in the forefront of world affairs, commercially and financially, we must give serious consideration to both the possibilities and probabilities of international economics.

Certainly with all the facts before them, it is not the part of wisdom, foresight and intelligent future planning, for American business men to "pass the buck" and forget what the morrow may bring forth.

M. Viviani has hit upon the most profound principle of all, when he says that the future development and progress of the world must be based upon international economic harmony.

That may sound platitudinous, but even platitudes may border on the practical and contain a germ of intelligence. Civilization has always advanced in proportion to the security with which people obtain their bread and butter. We think the situation is no different now.

ABSTRACTS

New Roentgenotherapy in Carcinoma.

M. J. SITTENFIELD, M. D.

Jour. A. M. A., January 8, 1921, Vol. 76, Page 99.

THIS paper was written on observations made during a visit to Germany in the summer of 1920, and covers the advances made there in one and one-half years. Technique in deep therapy has made great changes. In particular the establishment of accurate measurements has made possible the exact dosage in malignant and benign tumors.

With old apparatus an effective penetration of 3 to 5 cm., 80,000 to 140,000 volts, absorption of all rays with 3 mm. of lead, were the limits. In order to secure sufficient penetration at all depths many portals of entry were required. Now there are being used newer types of apparatus capable of generating 180,000 to 220,000 volts, requiring 25 mm. of lead to stop the ray and having an effective radiation of 10 cm.

To stand the extra strain three new tubes have been produced.

1. The Lilienfeld tube.
2. The Muller Siede-rohre, a water-cooled tube.
3. The Furstenau-Coolidge, an improved Coolidge.

This improvement in apparatus has given for use a spark of at least 16 to 18 inches. It has made possible the production of a homogeneous ray. That is, there is a point in a bundle of rays where no longer is it possible to change the ray by further filtration without simply reducing all the rays. This is possible with .8 cm. of copper.

Two instruments for the exact measurement have come into use. They are the electroscope of Wulf and the ionizing chamber of the new iontoquantimeter of Szillard.

Thus it is possible with 220,000 volts to obtain a 30 per cent homogeneous ray at a depth of 10 cm. Add to this 10 per cent for secondary radiation, give this thru front, sides and posteriorly, and the total is over 100 per cent that all parts will receive. Biologically, 100 per cent is considered an erythema dose. 5 to 95 per cent will destroy cancer cells, 60 per cent sarcoma cells, and 25 per cent the ovaries. Thus with a pathological and anatomical knowledge of the patient, it is possible to give the full dose all at one sitting, thus preventing stimulation and damage to the skin and connective tissue. The protection of the bladder and rectum can be made effective. Fortunately they stand higher dosage than the skin.

In Bumm's clinic in Berlin, cancer of the uterus is radiated through four fields; one large one over the entire abdomen, one directed from the back and one from each side. The distance is 30 cm. and .8 mm. of copper for filtration; the voltage is 180,000 to 200,00 with a 16 inch spark gap; ninety minutes to an area, making in all 360 minutes. Thus a patient is treated continuously for six hours. On account of the severe blood changes, the patient receives blood by transfusion and rests a few days in bed. Wintz had treated about 3,000 cases of uterine cancer in seven years. Seventy per cent of cancers of the body were arrested over four years. In cervical cancers 45 per cent were alive after four years. The population of this town is but 27,000. Seven thousand radiations are made in a year, and eight roentgen apparatus of the latest type are running eight to ten hours a day.

In the gynecologic clinic of Opitz in Freiburg the focal distance used is 50 cm. Four fields of radiation are used at 120 minutes each, thus consuming eight hours. The results are astounding. Since January 1, 1919, no cancer of the uterus has been operated upon. Opitz reported on 63 cases of cancer of the uterus thus: 41 of the cervix, 21 of the body. Of the cervix cases, 22 had receded, 10 were not influenced, and 9 had died. Of the body cases, 17, or 80 per cent, receded: two were not influenced, and two patients died.

Carcinoma of the breast is treated by the same hard ray, but less depth is necessary and so the tube is farther away—70 to 90 cm. from the skin. One area over the breast, one over the supraclavicular area, one laterally and one over the back are used. The time runs from four to eight hours. Morphine and scopolamine are used. He saw in one day 35 patients who

had been rayed two to four years before returning for observation, and all satisfactory. Now cases without axillary involvement are given roentgenotherapy rather than surgical treatment.

Carcinoma of the prostate is treated like a carcinoma of the uterus. Sarcoma does not require so much dosage. Osteosarcoma, tuberculous joints, fistulae and osteomyelitis are treated with gratifying results.

In uterine myomas the entire treatment is effected in one session of from one and one-half to two hours. One large field anterior and one posterior are taken. Each field is radiated for 40 minutes; in all 80 minutes. During the treatment exact measurements are read from the iontoquantimeter in the vagina. Compression is used by some. In fibroids, 85 per cent either shrink or disappear entirely, and in virtually all cases castration results. Malignant degeneration offers no contraindication.

SUMMARY

1. There have been constructed powerful high-tension transformers, and induction apparatus, with tubes to accept from 200,000 to 220,000 volts.
2. The determination of the homogeneous point and correct filtration through copper and zinc has brought about effective radiation.
3. Exact dosage for carcinoma tissue, 90 per cent of a skin erythema dose; for sarcoma 75 per cent, and for the ovary 25 per cent, has been established.
4. By the preoperative application of radiation the danger of transplanting cancer cells during operation is minimized.
5. Fibro-myomas respond to one treatment of from one and one-half to two hours, resulting in complete castration.
6. It is most important that all parts of the tumor receive an even and homogeneous radiation sufficient to destroy all cancer tissue and thus prevent recurrence.
7. Clinical knowledge as to the location of the tumor and its biology must accompany the skill of the roentgenologist, that he may intelligently select or combine surgery, radium, and the roentgen ray.
8. My own experience with this new technic since my return coincides at present with the work reported abroad, and I hope to give more detailed reports in the future.

Intracranial Aerocele Following Fractured Skull.

GILBERT HORRAX, M. D., BOSTON.

Annals of Surgery, January, 1921, Page. 18.

REPORTS of cases of air in the cranial cavity as a result of trauma are rare. In putting on record one case, an examination of the literature shows reference to x-ray evidence in cases reported by:

Luckett, W. H., Surg. Gyn. and Obst., 1913, xvii. 237.

Skinner, E. H., Jr. A. M. A., lxvi. 13, p. 954.

Holmes, G. W., Am. Jr. Roentgenology, 1918, v. p. 384.

Glenard and Aimard, Presse Medicale, xiv, March 10, 1919, p. 213.

Potter, H. E., Am. Jr. Roentgenology, vi. 1, 1919 p. 12.

May, A. J., Am. Jr. Roentgenology, vi. 4, 1919, p. 190.

Dandy has published the technic and findings in artificial ventriculography in Annals of Surgery, lxviii, 1, 1918, pp. 5-11. Also Bull. of John Hopkins, xxx. 336, 1919. Also Annals of Surgery, lxx, 4, 1919.

This patient was a girl, 19 years old, injured on June 9, 1919. An x-ray examination was made at the time, but no reference on the x-ray plate was made until July 8, 1919. By September, the air had disappeared and had caused no serious symptoms. There was a compound comminuted fracture of the skull involving the vertex and the base. No operative measures were indicated, and the patient was discharged. The following report is made on the roentgenogram:

> "In addition to this area (of defect) there was to be seen underlying the bony defect a lobulated shadow of decreased density which looked like a conglomerate mass of bubbles, the picture being such as to leave no doubt but that this irregular area represented an accumulation of air. Its extension backward within the cerebral tissue of the left frontal lobe for a considerable distance was shown by the lateral plate. The origin of this gaseous matter, presumably air, was unquestionably from a crack involving the frontal sinus."

Two Hundred and Fifty Operations on the Gall Bladder and Ducts.

EDGAR R. McGUIRE, M. D.
BUFFALO, N. Y.

Surgery, Gynecology and Obstetrics, Dec., 1921, Page 716.

IT IS the purpose of the reviewer to call attention only to the roentgen aspects of this excellent paper. The author says that the diagnosis of gall stones is usually not a difficult matter. After a careful history the x-ray is second in importance in making the diagnosis. Its greatest value is in the negative information obtained. It eliminates the other causes of pain, such as gastric and duodenal ulcer. He believes that the time is near at hand when gall stones will be as accurately diagnosed by x-ray as renal stones are today.

Renal Tuberculosis in Twins

HERMAN L. KRETSCHMER, M. D.

Annals of Surgery, January, 1921, Page 65.

THE points of interest in these cases are:

1. The occurrence of renal tuberculosis in twin girls.
2. The youth of the patients.
3. In one of the cases a bilateral process was demonstrated.
4. The demonstration of extensive calcification in renal tuberculosis in young individuals.
5. Calcification in the bilateral case occurred in the right kidney.
6. In the unilateral case the right kidney was involved, and it showed extensive calcification.

The patient with bilateral involvement was not operated and died. The other had one kidney removed and is doing well. The author has this to say about the roentgen findings:

"The amount of calcification in both cases was rather extensive, as evidenced by roentgen plates. In other cases of renal tuberculosis, which roentgenologically showed evidence of calcification, the shadows seen were very much smaller than in either of the cases above mentioned.

"For several years past, all cases of suspected renal tuberculosis, as well as assured cases, have been radiographed as a routine. It is surprising how often areas of calcification in the kidney region are found; hence roentgen ray examinations are dependable in giving additional information which in certain circumstances is not only helpful but desirable."

The prints presented are pathonomonic of renal tuberculosis and alone sufficient for a diagnosis, although some primary and many secondary clinical results are presented.

The Roentgenology of Appendical Obliteration.

E. H. SKINNER, KANSAS CITY

Jour. A. M. A., Dec. 11, 1920, Vol. 75, Page 1614.

THE purpose of this contribution is to postulate that the filling of an appendix lumen in an adult at least 30 years of age with an opaque meal is sufficient to nominate such an appendix as the seat of chronic disease. The degree of the pathology and the need of immediate or remote attention can only be told by the analysis of the case history and the elimination of other lesions by roentgen and clinical analysis.

The fermented milk and barium have no equal as a vehicle. The 48-hour period is the best time to observe the appendix. It fills by antiperistalsis, which is best seen in four hours, and also by sedimentation and mere gravity, due to a patent os.

In the analysis of appendiceal shadows the following points are pertinent.

1. Interrupted filling shadows caused by the presence of old non-opaque fecaliths or residues.
2. Narrowing of the lumen at the cecal end or along the appendical canal.
3. Bulbous end and narrowed neck.
4. Adhesions which kink, bind or distort.
5. Residues in the appendix after the cecum has relieved itself of opaque shadows.
6. Distinct tenderness over the appendiceal shadow.
7. A fixed appendiceal shadow in any part of its outline except the cecal end.

Authorities differ as to what the mere appearance of barium means.

Case says it is pathological; George that it is present in seven out of ten of all cases. Several others say that it does not pass into a normal appendix.

Appendices of children fill easily. But appendices over thirty years old are in dispute. In the discussion the following conclusions are reached:

1. The appendix is an organ of physiologic involution terminating in obliteration.
2. It is a lymphoid structure with a function.
3. It approximates and parallels the tonsils in its normal life history.
4. The appendix may be looked upon as an abdominal tonsil.

The pathologists are divided on their reports on the age of obliteration in appendix. The Europeans quoted seem to agree with the hypothesis as stated, and the Americans disagree. If found present after 30 it should be as carefully considered as a source of trouble as are the teeth and tonsils when looking for foci of infection.

SUMMARY

1. The appendix is a functionating organ.
2. It is a lymphoid structure.
3. It receives and expels colonic contents normally during childhood and adolescence.
4. It proceeds to physiological obliteration in adult life.
5. This obliteration is normally accomplished at about the age of 30.
6. Opaque filling of the appendix is easily secured in childhood and adolescence by meal and enema.
7. Appendiceal filling is a matter of sedimentation widely patent as an antiperistalsis. The three operate in childhood and adolescence. Antiperistalsis is more apparent with increasing years, and is the essential factor in the filling of appendices that are not obliterated after thirty years.

Roentgen-Ray Diagnosis of Intestinal Obstruction With Report of Cases

BY MAX KAHN, M. D., BALTIMORE, MARYLAND.

OBSTRUCTION of the intestines may be either congenital or acquired. Roentgenologically congenital obstruction is rarely seen. Congenital obstruction may be due to congenital stenosis, congenital deformities, strangulation by Meckel's diverticulum or the result of intra-uterine peritonitis forming peritoneal bands. Acquired obstruction is due principally to strictures following ulceration, intussusception, volvulus, strangulation by bands produced by peritonitis, by foreign bodies, by tumors extrinsic and intrinsic and tubercular peritonitis. Tubercular peritonitis is usually chronic and during its progress is apt to produce numerous and extensive adhesions about the intestines causing obstruction. The roentgen-rays offer material aid towards the diagnosis of obstruction, although the etiological factors may be difficult to determine The point of obstruction may at times be determined. The roentgenoscope will reveal without the opaque meal the distended bowel containing gas and fluid. This distention is usually quite marked in acute obstruction and can, as a rule, be easily recognized, so that in urgent cases this means alone may suffice for a diagnosis The

opaque meal, however, visualizes the intestines more clearly and where possible should be employed. The use of the meal does not produce ill effects and does not endanger the patient. In the small intestines the point of obstruction is difficult to localize unless it occurs at either extremity. In the large intestines the site of obstruction can frequently be determined with the opaque meal from above and the opaque enema from below. Roentgenoscopically one may be able to note the increased persistalsis proximal to the site of obstruction in addition to the distention. We have never seen anti-persistalsis in obstruction. In acute obstruction increased peristalsis is not readily seen. The roentgenological characteristics of obstruction of the small intestines are a distended bowel having a reticulated appearance containing gas and fluid. In one of our cases of chronic obstruction the distention of the small intestines at the end of eighteen hours was most marked and roentgenoscopically simulated the large bowel.

Case 1. This case was that of a white male, age 53. Family history is negative. Personal history, had the usual children's diseases, but no other sickness. He has always been in good health until a month previous to this examination. Wasserman, negative. Present illness complains of some rolling and excessive motion of the intestines two or three hours after eating. There is no regular nausea after meals, but he has frequent vomiting. He usually vomits three to four times on two to four-hour intervals. He vomits no food, but yellow and dark green fluid, occasionally of a brownish color. No dark coffee ground vomitus. No hematemesis. No soreness of abdomen. The roentgenological study of the gastro-intestinal tract May 20th and 21st, 1920, revealed an irregularity in the pyloro-duodenal region suggesting deformity due to adhesions causing stenosis and delay in the normal emptying time of the stomach. The small intestines at the end of eighteen hours were greatly distended, had a reticulated appearance and contained gas and fluid. Roentgenograms made at hourly intervals after eighteen hours revealed the small intestines constantly distended. The diagnosis of obstruction in the pyloro-duodenal region and of the small intestines, probably in the region of the

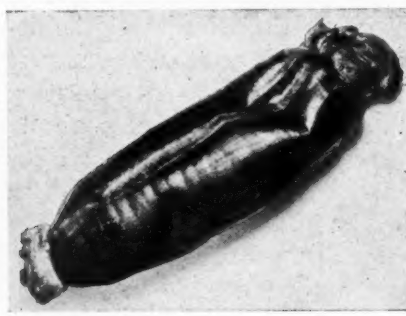
Case I.—Fig. I.—Note marked distention and reticulation of the small intestine. Obstruction due to adenocarcinoma of the jejunum. Also note the irregularity in the pyloro-duodenal region, due to a band of adhesions, causing stenosis.

jejunum, was made. Operation by Dr. Bloodgood May 31st, 1920. His notes of the operative findings are as follows: No fluid. A band of connective tissue with fat extends from the lesser

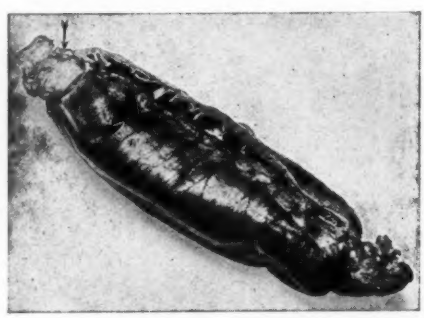
to the greater curvature constricting the pylorus. When this was divided the patency of the pylorus was restored. The gall bladder was distended, walls thin, no stone present.

Case I.—Fig. II.—Same as Fig. I., several hours later. The distention and reticulation of the small intestine persisted for over thirty hours.

There were adhesions between the gall bladder and duodenum easily separated. The duodenum was not dilated but instead of it being huge it was a distinct S, suggesting it had been dilated, but there was no evidence of ulcer of duodenum or stomach. The stomach was somewhat dilated, but apparently empty. The appendix was long and free, the cecum normal. On lifting up the omentum and transverse colon, loops of rather collapsed intestines presented themselves. On introducing the hand, the operator felt and withdrew a huge loop of jejunum. It was of the diameter of an adult colon, thick walled and the distention extended up to the mesenteric vessels. There was a definite ring stricture. The length of this distended gut was about four feet. It is the gut which shows in the x-ray. There are no adhesions. Near the stricture is a palpable gland. Resection was done with isolation and ligation of the mesenteric vessels removing the glands. Two inches of the gut below the stricture and eleven inches above was removed. This long piece was removed because there was a patch of white tissue on the peritoneum, suggesting that it had been adherent to



Case I.—Fig. III.—Resected jejunum. Note patch on the peritoneum, suggesting that it had been adherent to the stricture.



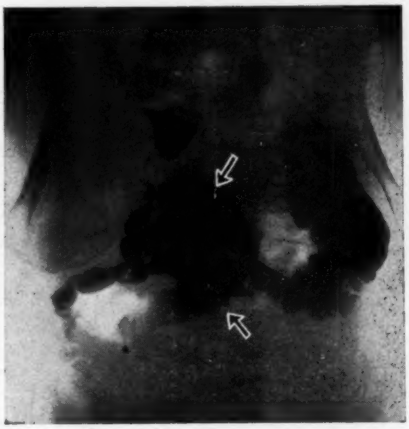
Case I.—Fig. IV.—Another view of resected jejunum. Arrow points to stricture.

the stricture. The small jejunum below the stricture was inverted as the appendix is done, the larger closed, as colon. A lateral anastomosis, Bloodgood's method, was done, the ends pointing in opposite directions, interrupted silk sutures being used. The abdominal wound was closed with buried catgut. Silver wire through and

through. No shock. Gross Pathology. At the position of the stricture there was a small area like cancer. The frozen section showed adeno-carcinoma. This is the first cancer I have observed in the small intestines.

Case I.—Fig. V.—Jejunum cut open, revealing stricture due to adeno-carcinoma.

Case 2. White male, age 51, married, occupation clerk. Personal history, he has had the usual children's diseases. Has otherwise never been ill excepting that he has been troubled with hemorrhoids for the past twenty-five years. Present illness: Three weeks ago intense pains in his abdomen began and lasted the four following days. The day after the beginning of the pains he vomited. The vomitus was fluid of a yellow color, no hematemesis, no coffee ground vomitus. He had no bowel movement for the four days from the beginning of the pains. Purgatives appeared ineffectual and caused vomiting. He was relieved of the pains after bowel movement, following an enema. At present he has very little pain, but has lost about five pounds in weight in the past three weeks. On palpating the abdomen immediately above the umbilicus, pain is elicited. No tumor mass at this time is palpable. A roentgenological study of the gastro-intestinal tract was made July 14th and 15th, 1920. The stomach was negative for organic lesion. There was a delay in the emptying time of the small and large intestines. At the



Case II.—Fig. VI.—Note distended and reticulated appearance of the small intestine. Obstruction due to a number of contracted rings shutting off segments about four inches long.

Case II.—Fig. VII.—Forty-eight hours after barium ingestion reveals the head of the barium column only as far as the right half of the transverse colon, suggesting possible obstruction of transverse colon.

end of twenty-four hours there was considerable barium in the small intestines, which appear markedly distended and apparently contain a small amount of gas and fluid, suggesting

obstruction. At the end of forty-eight hours there was some barium remaining in the cecum, ascending colon and as far as the right half of the transverse colon. A barium enema visualizes practically the entire colon with the exception of an area in the sigmoid and a small area in the descending colon. These filling defects in all probability are not organic. Impres-

Case II.—Fig. VIII.—Barium enema proves there is no obstruction of the transverse colon. Arrow points to where band of adhesions was found in the sigmoid producing constriction.

sion—The delay in the emptying time of both the large and small intestines, with the marked distention of the small intestines is strongly suggestive of obstruction in the region of the lower jejunum or upper ileum. Operation by Dr. McGlannan July 27th, 1920. The operative note is as follows: Left rectus incision. The small intestine was spastic and there were a number of contracted rings shutting off segments about four inches long. The sigmoid was carefully explored and one band divided near its upper part. Nothing could be felt in the pelvis nor in the cecum. The small intestines were carefully explored, beginning at the cecum. About two feet away we brought up a loop from which there projected a little band which had evidently been recently torn. It was covered with a blood clot and situated opposite the mesentery on the wall of the bowel. This had evidently been the cause of the obstruction. This point was turned in and sutured with Pagenstecker. Nothing else was found in the exploration. Abdomen closed with #O chromic in all layers except the skin, where silk worm gut was used. Diagnosis: Chronic intestinal instruction. Inflammatory band.

Case 3. White female, age 45. Married. Personal history unimportant excepting that she has been operated on twice, once in July, 1901. The patient does not remember the nature of this operation. Operated on the second time in May, 1908, when the pelvic organs were all removed. She was at the same time operated on for hemorrhoids. Present illness began December 30th, 1914, at about 6 P. M., before patient ate supper, with severe pain in the lower part of the abdomen. The patient tried to eat supper but the pains became more severe. She was awake all night with intense pain. She saw her physician on the morning of December 31st, 1914, and called him twice later. The patient felt nauseated and vomited, but had no bowel movement. She was brought to Saint Agnes Hospital in the evening of December 31st suffering intense pain in the lower abdomen. A roentgenoscopic examination was made soon after the patient was admitted. The findings were as follows: The intestines appeared greatly distended with gas, and apparently also contained some fluid. The distention was particularly more marked in the small intestines. Owing to the condition of the patient it was thought inadvisable to subject her to further examination. Operation December

31st, 1914, by Dr. McGlannan. His note of the operative findings follows: High left rectus incision. Small amount of clear fluid. No obstruction found at splenic flexure. Dilated loop of gut felt in lower abdomen. Wound packed with large Boston pads and covered with a towel. Second incision, a low left rectus near the median line. Large amount of clear fluid. Long loop of ilium (two feet) near the lower end markedly dilated and discolored. There are adhesions between the loops of bowel and also adhesions between the bowel and parietal pelvic peritoneum. These adhesions (2) are very thick and the bowel had become twisted. The adhesions were cut and loops relieved. Diagnosis: Acute obstruction of the small intestines caused by post operative adhesions.

In summarizing, we feel that obstruction of the intestines can, as a rule, be demonstrated, and is characterized in the small intestines by distention, the bowel having a reticulated appearance of containing gas and fluid. The etiological factors concerned in obstruction and the points of obstruction in the small intestines are usually difficult of demonstration. In the large intestines the point of obstruction can frequently be demonstrated from above and confirmed by enema. In acute obstruction, where the condition of the patient prevents an extended study, the roentgenoscopic examination alone is of great help. Where possible roentgenograms should be made.

X-Ray Treatment of Epidermophyton Infection of the Feet

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THE suggestions offered in this paper were gathered from the treatment of not more than twenty cases of this disease, during the past eight months. The results obtained have been so highly satisfactory, that I feel inclined to offer them for your consideration, doing so, however, somewhat in the nature of a preliminary report.

Epidermophyton infection is by no means a rare or new disease. In fact, it is very common and without doubt very old. Still it is only within the last few years that it has been established as a separate entity, its cause determined, its course and symptons accurately described, and its treatment and cure worked out.

When Dr. Ormsby and Dr. Mitchell read their excellent paper on this subject before the Dermatological Section of the American Medical Association in June, 1916, Dr. Pusey remarked in the subsequent discussion that the disease was undoubtedly very common and equally undoubtedly seldom recognized.

Charles White in the Journal of Cutaneous Diseases for August, 1919, says that "half of the authors of recent treatises on dermatology write as if from hearsay rather than from first hand knowledge," and he believes that the bulk of the profession is still "ignorant of the very existence of this condition."

White also speaks of curing a patient *this year* who had suffered from this infection for thirty years. A man of wealth and prominence, who had suffered much at the hands of many physicians, who had sought relief and found it not—reminding one of the tortures of Napoleon, who in spite of all his pomp and power, scratched and swore for twenty years, because he was born before bacteriology and after scabes.

In view of these statements, I think it will not be going too much into detail at this point to give a brief description of the disease as it is generally seen, and to emphasize the several points of peculiarity which the disease presents when it attacks the feet.

The infectious agent in this disease is the epidermophyton inguinale. This was definitely proved and established by Sabouraud in 1910. There is still nothing definitely known as to how this micro-organism finds lodgement within the human skin. The name given by Sabouraud to this microscopic plant would indicate that the disease is confined to the inguinal region, but such is by no means the case. On the contrary, the disease may be encountered on almost any part of the body—thighs, toes and feet, fingers and hands, the axillæ, the genitalia, the flat surface of the trunk, and the scalp. By far the greatest number of cases, however, occur on the inner surface of the thighs and upon the feet.

The reaction of the skin to this invading plant varies considerably with the quality of the skin, its situation and the amount of moisture present. Therefore the clinical appearance of the disease is not the same in all parts of the body. There are two symptons, however, which are constant, itching and sharply localized areas of redness or copper-color. Itching, however, varies to a great extent. On the extensor surfaces it is mild, while between the toes and on the labia it is almost intolerable.

When this organism finds lodgment in the feet, the reaction ingendered presents a clinical picture far more characteristic and more readily recognized than in any other part of the body. Here the diagnosis can usually be made clinically, while in other parts of

Apart from the fact that this fungus is so easily influenced by the ray, there are two other reasons why this should be the agent of choice in treating this disease: First, the x-ray will remove the secondary pathology, and in cer-

tain diseases the secondary pathology persists after the primary has been overcome. In this case, the secondary pathology is the hyperhidrosis and the callous formation. The x-ray will control both. The second reason for using the ray is this: Most of these feet like most most feet in general, have corns, hard or soft, to add to their discomfort and suffering. There is no tissue in the body much more susceptible to the action of the x-ray than ordinary corns. Nor is there any other minor ailment which can render one more thoroughly uncomfortable.

In treating a severe case of epidermophyton infection of the feet with the x-ray we will be able to cure the disease rapidly, put a stop to the excessive sweating, remove all calosities, and incidentally rid the patient of all corns, both hard and soft.

The technique in the treatment of these cases is simple indeed. I mentioned above that the infecting organism is very susceptible to the action of the x-ray. For this reason small doses will suffice. I usually give at one sitting two-thirds of an erythema dose of the unfiltered ray to each area involved—using about seven and one-half inch penetration. Following the application of this dose, cessation of all symptoms sets in within twenty-four hours. I sometimes say to my patients go and scratch no more, and let me see you again in about three weeks.

Subsequent doses I think should be filtered, for deeper penetration which may or may not be necessary, and because the skin is less likely to be injured.

The results of the first dose are indeed brilliant and rapid. The patient is nearly cured in just a few minutes treatment, and this without sticky ointments which have likely been used for a long time with little or no benefit. But in spite of this brilliant beginning, the end is not yet. Some of the organisms seem to survive, or possibly the patient is re-infected from his own shoes, and in time these begin to multiply and a relapse sets in, which calls for further treatment. For this reason these patients should be kept under regular observation for some months.

I believe the best practice to be this: Give one, or possible two or three x-ray treatments at proper intervals to bring the disease rapidly under control and to relieve the feet of secondary pathology if present, and then prescribe Whitfield's ointment to help complete the cure and guard against relapses.